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Assessment of food group intake in Korean population with a newly developed food group database

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ABSTRACT

The aim of this study was to establish a food group database for Korean foods and to assess food group intake in Korean population by sex and age group. The newly developed database consisted of 4370 foods and provided common serving size and number of food group servings per 100 g of each food for six food groups (i.e. grains, meat–fish–eggs–beans, vegetables, fruits, milk–dairy products, and oils–fats–sugars). The common serving size referred to the Korean Food Guidance System (KFGS), Korean dish recipes, and other references. Consumed number of food group servings were calculated with a single 24-h recall dietary data of 16,492 subjects (≥ 3 years) from the 2009–2010 Korea National Health and Nutrition Examination Survey, and compared with a recommendation from the KFGS by sex and age group. Mean intake level of fruits did not reach the recommendation in adolescents and adult men and mean intake of milk–dairy products was the least likely to meet the recommendation in all the sex and age groups. Mean intake level of oils–fats–sugars was higher compared to the recommendations across all the sex and age groups, with the exception of older adults. The database from this study may be useful to guide and assess food group intake in the Korean population.

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1. Introduction

Numerous epidemiological studies have demonstrated the association between dietary intake and chronic diseases such as diabetes, cardiovascular diseases, and cancer. These studies have in turn led to the development of measures to guide and evaluate the dietary patterns of individuals and populations. Food-based dietary guidelines are a practical method to help individuals better understand and follow more healthful dietary practices. Most countries have set recommended food group intake values to guide individuals in adopting healthful eating habits. The food group intake of populations can be evaluated based on such guidelines (Katamay et al., 2007; Sirichakwal et al., 2011; KNS, 2010; USDA, 2011; Yoshiike et al., 2007).

Krebs-Smith et al. (2010) converted the amount of food consumed in the 24-h recall data obtained from the US National

Health and Nutrition Examination Survey (NHANES) into servings by food group and compared these values against the US Department of Agriculture (USDA) MyPyramid recommended servings for each food group by sex and age group. When assessing the intake of a specific food group, such as vegetables or fruits, the proportion of the population consuming less than the recommended number of servings of MyPyramid for that food group was observed (Guenther et al., 2006). Furthermore, MyPyramid was used to note food group intake according to specific age (Knol et al., 2006) or ethnic groups (Sharma et al., 2003b, 2004). Food group intake in terms of inadequate or excess intake by each food group was thus shown to vary according to age or ethnic groups.

The Korean Food Guidance System (KFGS), in the Dietary Reference Intakes for Koreans (The KNS, 2010), provides common serving sizes of Korean foods for the six food groups (i.e. grains, meat–fish–eggs–beans, vegetables, fruits, milk–dairy products, and oils–fats–sugars) that contribute to a balanced diet. The number of servings from each food group that corresponds to energy and nutrient requirements is provided with respect to sex and age group so that individuals can be aware of their food group intake. In addition, the KFGS can be used to evaluate food group intake based on the recommendations given.

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The KFGS recommendations for vegetables, fruits, and milk-dairy products were included in the Korean Diet Quality Index and used for the evaluation of diet quality in diverse age groups by Shim et al. (2002). Shim et al. (2009) also used the KFGS to evaluate the dietary quality of school-aged children from low-income households and reported that intakes of fruits and milk-dairy products were lower in children of low-income families compared to those of average-income families. Jung et al. (2011) examined the association between the risk of metabolic syndrome and intakes of six food groups of the KFGS. They found that low intake of milk-dairy products was positively associated with an elevated risk of metabolic syndrome. These findings from previous studies have shed light on the importance of food guidance based on an assessment of actual food group intake.

The KFGS included foods that were commonly purchased and consumed, low in saturated fat and added sugar as well as good for health, and presented the common serving sizes by each food. However, the foods listed in the KFGS do not represent the foods consumed by the entire population, which poses a challenge in making dietary assessments and in devising suitable meal plans. Therefore, developing a database that provides serving sizes of foods commonly consumed in Korea and the classification of food group is needed to guide and assess the intake of food group with the KFGS recommendation. The aim of this study was to develop a serving size database for common Korean foods according to food group and to evaluate the intakes of six food groups based on the recommendation of the KFGS by sex and age group.

2. Materials and methods

2.1. Establishment of food group database

2.1.1. Food list

To develop the food group database, two food lists were used: (1) 2506 food items from the Food Composition Table of Rural Development Administration (RDA, 2006) in Korea, and (2) 2608 food items from Korea National Health and Nutrition Examination Survey (KNHANES) food code book (KCDC, 2010a). Among the 5114 food items, those that were consumed in very small amounts or contained only trace amounts of energy and/or nutrient (e.g. seasonings, tea, and alcohol) or had insufficient information in assigning common serving size (e.g. milk formula and baby food) were excluded from the list (744 items), leaving a total of 4370 food items in the final database.

2.1.2. Assignment of common serving size and food group

Each food item was assigned to at least one of six food groups: grains, meat–fish–eggs–beans, vegetables, fruits, milk-dairy products, and oils–fats–sugars with appropriate serving sizes. The food items had at least one of the following characteristics: (1) they matched the KFGS foods; (2) they do not match the KFGS foods; or (3) they were composed of several ingredients (mixed foods). Table 1 shows the basic structure and criteria of the assignment of serving sizes and food groups.

If the food items in the list were identical or similar to the food items in the KFGS, the common serving size and food group of foods listed in the KFGS (KNS, 2010) was used in our database. Based on the common serving size and food group, the number of servings per 100 g of each food was suggested for six food groups. For example, uncooked rice is a KFGS food under the grains group and common serving size is 90 g. Thus, uncooked rice provides 1.11 servings per 100 g for grains. In the case of cooked rice of which the common serving size is 210 g, 100 g of cooked rice would be equivalent to 0.48 servings in the grains group.

In the case of food items that were identical or similar in name to the KFGS food items but different in form (e.g. boiled, dried, or frozen), the serving sizes were modified to account for the energy and water content of the KFGS foods. To give an example, the common serving size of raw meat is 60 g based on the KFGS (1.67 servings per 100 g), but since one serving size of cooked meat is 42 g, it would provide 2.38 servings per 100 g. Foods particularly high in fat and/or sugar content compared to the KFGS foods were assigned a separate number of servings in the oils–fats–sugars group in reference to the Food Composition Table (RDA, 2006) (e.g. canned fruits, pork belly, fried meat or fish, and sugar-sweetened beverages).

There are a total of 793 food items not listed in the KFGS (approximately 18%). Wheat flour, snacks, instant noodles, salted fermented fish, dried fruits, and salad dressing are some examples. The number of food group servings for these foods were assigned in reference to the common serving size provided by RDA food nutrient data by portions commonly used (RDA, 2009) and the Korean Dietetic Association's food photo of the eye-to-weight (KDA, 1999). For processed foods with manufacturer and product name specifically indicated, the nutrition facts label and information on nutrient composition provided by food company websites were used to determine common serving sizes and the number of servings per 100 g in the food groups. Foods that showed large differences in energy, fat, and sugar content compared to other foods from the same food group (e.g. snacks, instant noodles, and bread with high fat and sugar) had separate number of servings in the oils–fats–sugars group were assigned.

A total of 116 mixed foods (e.g. sandwich, pizza, hamburger, and dumpling) were disaggregated into their basic ingredients by referring to recipe databases. The number of food group servings was assigned for each of those ingredients (USDA, 2008). Korean recipe database from CAN-Pro 3.0 Software (KNS, 2005) and Dietary Evaluation System (The Human Nutrition Lab, 2011) were used. To give an example, an egg and cheese sandwich would be broken down into white bread, egg, and cheese ingredients and the number of servings per 100 g of the sandwich would be 0.6 for the grains group, 0.5 for the meat–fish–eggs–beans group, and 0.75 for the milk-dairy products group.

2.2. Assessment of food group intake

2.2.1. Subjects

One-day dietary intake data obtained by a 24-h recall method in the 2009–2010 KNHANES that contains a nationally representative, complex multi-stage and stratified probability sample was used for this study (KCDC, 2010a). Individuals aged 3 and above who had participated in the dietary survey were considered as eligible subjects ($n = 17,410$). After excluding for subjects with unusually high or low energy intake (<500 or >5000 kcal/day), or pregnant or of breastfeeding status, a total of 16,492 subjects (7338 men and 9154 women) were selected for the final data analyses. The distribution of the study subjects by sex and age group is shown in Table 2.

2.2.2. Calculation of food group intake

The mean food group intake in numbers of servings from each subject was calculated based on the newly developed database. To evaluate food group intake, the percentage of servings recommended in the KFGS was calculated according to sex and age group. The KFGS recommended specific patterns of food group intake in numbers of serving for individuals within their energy and nutrients requirements assuming a sedentary activity level according to sex and age group. For example, it is recommended that sedentary women aged 19–64 years with energy requirements of about 1900 kcal should consume 3 servings from the grains, 4 servings from meat–fish–eggs–beans, 7 servings from

Table 1

Basic structure of a newly developed food group database for common Korean foods.

	Number of servings per 100 g of a food item ^a						Common serving size (g)	Criteria ^b
	G	M	V	F	D	O		
Food items on the KFGS ^c (total = 3461)								
White rice, raw	1.1	0	0	0	0	0	90	1
White rice, cooked	0.5	0	0	0	0	0	210	1
White bread	1.0	0	0	0	0	0	100	1
Chicken, raw	0	1.7	0	0	0	0	60	1
Chicken, fried	0	2.4	0	0	0	1.9	42	1-A
Pork, raw	0	1.7	0	0	0	0	60	1
Pork, roasted	0	2.4	0	0	0	0	42	1-A
Pork, belly, raw	0	1.7	0	0	0	1.7	60	1-A
Kidney bean, dried	0	5.0	0	0	0	0	20	1
Kidney bean, cooked	0	3.3	0	0	0	0	30	1-A
Carrot, raw	0	0	1.4	0	0	0	70	1
Cabbage kimchi	0	0	2.5	0	0	0	40	1
Mushroom, raw	0	0	3.3	0	0	0	30	1
Mushroom, dried	0	0	16.7	0	0	0	6	1-A
Peach, raw	0	0	0	1	0	0	100	1
Peach, canned	0	0	0	1	0	1	100	1-A
Whole milk	0	0	0	0	0.5	0	200	1
Chocolate flavored milk	0	0	0	0	0.5	0.5	200	1-A
Jam	0	0	0	0	0	10.0	10	1
Mayonnaise	0	0	0	0	0	20.0	5	1
Instant coffee mix (including sugar and creamer)	0	0	0	0	0	8.3	12	1
Carbonated beverage, coke	0	0	0	0	0	1.0	200	1-A
:			:					
Food items not on the KFGS (total = 793)								
Wheat flour	1.1	0	0	0	0	0	45 ^d	2
Instant noodle (Ramen), dried	0.8	0	0	0	0	2.8	120	2-A
Bread with jam	0.7	0	0	0	0	3.0	100	2-A
Doughnut	1.0	0	0	0	0	3.2	100	2-A
Corn, dried	3.3	0	0	0	0	0	30	2
Squid, salt-fermented	0	10.0	0	0	0	0	10	2
Persimmon, dried	0	0	0	3.1	0	0	32	2
Salad dressing	0	0	0	0	0	10.0	10	2
:			:					
Mixed foods (total = 116)								
Sandwich with egg and cheese	0.6	0.5	0	0	0.8	0	100	3
Pizza	0.4	0.1	0.5	0	0.9	0	145	3
Dumpling	0.5	1.2	0.9	0	0	0	150	3
Fried rice with ham	0.6	0.2	0.3	0	0	0	250	3
:			:					

^a G, grains; M, meat–fish–eggs–beans; V, vegetables; F, fruits; D, milk–dairy products; O, oils–fats–sugars.^b Criteria of the food items assigned to common serving sizes and food groups were categorized by the following characteristics: (1) food items that match the KFGS foods, (2) food items that do not match the KFGS foods, (3) foods consisting of several ingredients (mixed foods), and (A) food items with different contents of energy, fats, or sugars compared to the KFGS foods.^c KFGS, Korean Food Guidance System.^d 0.5 serving.**Table 2**

Distribution of the study subjects from the 2009–2010 Korea National Health and Nutrition Examination Survey data by sex and age group.

Age group (years)	Total		Men		Women	
	n	(%)	n	(%)	n	(%)
3–5	721	(4.4)	372	(5.1)	349	(3.8)
6–11	1652	(10.0)	857	(11.7)	795	(8.7)
12–18	1561	(9.5)	823	(11.2)	738	(8.1)
19–29	1534	(9.3)	664	(9.1)	870	(9.5)
30–49	4742	(28.8)	1932	(26.3)	2810	(30.7)
50–64	3321	(20.1)	1417	(19.3)	1904	(20.8)
65–74	1993	(12.1)	877	(12.0)	1116	(12.2)
≥75	968	(5.9)	396	(5.4)	572	(6.3)
Total	16,492	(100.0)	7338	(44.5)	9154	(55.5)

vegetables, 2 servings from fruits, 1 serving from milk–dairy products, and 4 servings from oils–fats–sugars.

2.2.3. Statistical analyses

All statistical analyses were conducted using SAS software version 9.3 (SAS Institute, Cary, NC, USA). The KNHANES data from

2009 and 2010 were combined with appropriate sampling weights from the national survey. The Taylor series method was used to account for the complex sampling design effect. Six food group intake by each sex and age group was suggested as mean number of servings and 95% confidence limits (95% CL) and percentage (%) of recommended servings.

Table 3

Composition of assigned food groups to each food item in a newly developed food group database.

Composition of food group	Total	Grains	Meat–fish–eggs–beans	Vegetables	Fruits	Milk–dairy products	Oils–fats–sugars
<i>No. of food group</i>				<i>No. of food items</i>			
1	3672	411	1451	653	204	373	580
2	596	439	80	4	18	69	582
3	40	39	32	38	0	2	9
4	53	53	53	53	0	19	34
5	9	9	9	9	0	9	9
Total	4370	951	1625	757	222	472	1214

3. Results

3.1. Composition of the food group database

Table 3 shows overlapped number of assigned food groups in the food group database. Accounting for approximately 84% of the database, 3672 of the 4370 food items were assigned to only one type of food group. Meat–fish–eggs–beans group contains the most number of food items, whereas the fruits group contains the fewest. Foods that were assigned to two or more food groups accounted for 16% of the total items with a total of 698. Foods assigned to three or more food groups were predominantly classified under the grains, meat–fish–eggs–beans, and vegetables groups, but none were in the fruits group. The highest number of food groups to which any one food item was assigned was five (all except fruits), e.g. hamburger.

3.2. Food group intake in the Korean population

The mean number of servings consumed for the six food groups and the comparison with recommended servings by sex and age group is presented in Table 4. The intake of grains was close to the recommended servings in most ages and sex. With the exception of boys and men of age 6–11 years and 19–64 years, the number of servings of meat–fish–eggs–beans consumed were fewer than those recommended. For the same food group, the lowest intake was observed in children of 3–5 years with 71% of recommended servings, compared boys of 6–11 years who showed the highest intake with 109%. Most of the subjects aged 19 years and under consumed fewer than 100% of servings of vegetables, while intake in 19 years and above was higher than the recommended number of servings. Fruits consumption in adolescents aged 12–18 years and men aged 19–64 years was particularly low compared to the recommendations (boys aged 12–18 years consumed 63%; girls aged 12–18 years, 71%; men aged 19–64 years, 52%). A particularly low intake of servings of milk–dairy products was observed which applied to all age and sex groups; the overall intake of milk–dairy products in adults 19 years and older reported not having consumed even half the recommended servings. Intake of oils–fats–sugars was 78% of recommended servings in men and 62% of recommended servings in women of 65 years and above, whereas other age groups, for the same food group, showed higher-than-recommended numbers of servings.

4. Discussion

To our knowledge, this study is the first attempt to establish a database for food group servings of Korean foods and to assess food group intake disaggregated by age groups and sex in reference to recommended servings from the KFGS. This study used the KFGS and other data as references to set common serving sizes of 4370 commonly consumed foods in Korea and to provide appropriate number of servings for six food groups in 100 g of the food items. Food group

intake of Koreans differed substantially between age groups in both sexes. In all the sex and age groups, actual intake of oils–fats–sugars was higher than the recommended number of servings (apart from 65 years and older), whereas the intake of milk–dairy products was markedly lower than the recommended servings.

These results may be partially explained due to the typical Korean meal pattern, which comprises steamed rice, savoury soup, and seasoned side dishes (Park et al., 2003). Grains, meat–fish–eggs–beans, and vegetables are consumed daily as staple foods, unlike fruits and milk–dairy products that are consumed on a less frequent basis – more or less as between-meal snacks. Considering the fact that the consumption of food groups was calculated from the data from single 24-h recall, the possible risk in over-exaggerating insufficient intakes cannot be completely dismissed. However, the food frequency questionnaire data from the Fourth KNHANES reported that Koreans of 12 years and older consumed milk and yogurt three times and once a week on average, respectively, with the frequency being much less in the elderly of 65 years and older (1.5 times for milk and 0.5 times for yogurt) (KCDC, 2010b), reflecting an overall poor consumption of milk–dairy products among the general population of Korea. The rich amount of nutrients present in milk–dairy products, such as calcium and riboflavin but which tend to be low in the typical Korean diet, make this an important food source group for growth in children and adolescents (Brown et al., 2011). In addition, previous studies reported that intake of milk–dairy products was associated with reduced risk of chronic diseases, such as cancer, cardiovascular disease, and diabetes (Azadbakht et al., 2005; Choi et al., 2005; Liu et al., 2006; Wang et al., 2008) for adults. Such growth and health benefits of milk–dairy products among diverse age groups would indicate that increasing their intake could be of significant nutritional value.

Low intake of fruits in adolescents and adult men and high intake of oils–fats–sugars in children, adolescents, and middle-aged adults observed in this study might result in poor nutritional status and health problems for these population groups. Previous studies reported that inadequate consumption of these food groups was associated with overweight or obesity in children and adolescent populations (James et al., 2004; Bradlee et al., 2010), and chronic diseases in adult populations (Takachi et al., 2008; Cohen et al., 2010; Jung et al., 2011; Wang et al., 2012).

From the results of this study, a particularly low intake of meat–fish–eggs–beans, vegetables, fruits, and milk–dairy products in adolescents aged 12–18 years can be observed. As mental and physical development is at its peak during this period, the body's greater demand for nutrients need to be complemented by adequate intake of nutrients and healthy dietary habits, which are, in fact, also known to bear a positive influence on academic and social performance (Brown et al., 2011). Meat–fish–eggs–beans are sources of protein, and vegetables, fruits, and milk–dairy products are sources for vitamins and minerals; thus these groups are essential for the body's well-being.

In our database, foods high in saturated fat and/or sugar content were given an additional, but separate, number of servings of

Table 4Food group intake of the study subjects from the 2009–2010 Korea National Health and Nutrition Examination Survey data by sex and age group.^a

Age/sex group	Food group ^b	Recommendation ^c No. of servings	Consumption			
			Mean	95% CL	% Recommendation ^d	
			No. of servings		%	
3–5 years, children (n = 721)	G	2.0	2.1	2.0	2.2	104.1
	M	3.0	2.1	2.0	2.3	70.9
	V	5.0	3.3	3.1	3.5	65.6
	F	1.0	1.6	1.4	1.8	159.5
	D	2.0	1.3	1.2	1.4	67.2
	O	2.0	3.3	3.0	3.6	164.0
6–11 years, boys (n = 857)	G	3.0	3.1	3.0	3.2	103.4
	M	3.0	3.3	3.1	3.5	109.2
	V	5.0	5.0	4.7	5.3	99.1
	F	1.0	1.7	1.5	2.0	170.5
	D	2.0	1.3	1.2	1.4	63.5
	O	3.0	5.2	4.8	5.5	172.2
6–11 years, girls (n = 795)	G	2.5	2.7	2.6	2.8	108.8
	M	3.0	2.7	2.6	2.9	90.1
	V	5.0	4.6	4.3	4.9	92.2
	F	1.0	1.5	1.3	1.7	153.5
	D	2.0	1.2	1.1	1.3	57.7
	O	3.0	4.6	4.2	5.0	152.2
12–18 years, boys (n = 823)	G	4.0	3.8	3.7	3.9	95.2
	M	6.0	4.3	4.0	4.6	71.6
	V	7.0	6.5	6.1	6.8	92.2
	F	2.0	1.3	1.1	1.5	62.7
	D	2.0	1.1	1.0	1.3	56.4
	O	6.0	7.3	6.8	7.7	121.1
12–18 years, girls (n = 738)	G	3.0	3.0	2.9	3.1	100.7
	M	4.0	3.2	3.0	3.4	80.7
	V	7.0	5.2	4.9	5.5	74.1
	F	2.0	1.4	1.2	1.7	71.2
	D	2.0	0.9	0.8	1.0	42.7
	O	4.0	6.9	6.3	7.6	173.4
19–64 years, men (n = 4013)	G	4.0	3.5	3.5	3.6	88.5
	M	5.0	5.1	4.9	5.2	101.1
	V	7.0	10.1	9.9	10.3	143.7
	F	3.0	1.6	1.4	1.7	51.7
	D	1.0	0.5	0.4	0.5	46.2
	O	5.0	6.9	6.6	7.1	137.3
19–64 years, women (n = 5584)	G	3.0	2.8	2.8	2.9	93.6
	M	4.0	3.2	3.2	3.3	81.0
	V	7.0	7.6	7.4	7.7	107.8
	F	2.0	2.1	1.9	2.2	103.9
	D	1.0	0.6	0.5	0.6	55.2
	O	4.0	4.7	4.6	4.9	117.4
≥65 years, men (n = 1273)	G	3.5	3.6	3.5	3.6	101.3
	M	4.0	3.1	3.0	3.3	78.3
	V	7.0	8.8	8.5	9.2	126.3
	F	1.0	1.4	1.1	1.6	136.6
	D	1.0	0.2	0.2	0.3	24.1
	O	4.0	3.1	2.9	3.4	77.8
≥65 years, women (n = 1688)	G	3.0	3.1	3.0	3.1	102.4
	M	2.5	1.9	1.8	2.0	74.9
	V	5.0	6.3	6.1	6.6	126.4
	F	1.0	1.2	1.1	1.4	123.8
	D	1.0	0.2	0.2	0.3	23.5
	O	3.0	1.9	1.7	2.0	61.8

^a All analyses accounted for the complex sampling design effect and appropriate sampling weights of the national survey.^b G, grains; M, meat–fish–eggs–beans; V, vegetables; F, fruits; D, milk–dairy products; O, oils–fats–sugars.^c Recommendation for intakes of six food groups were from the Korean Food Guidance System of Dietary Reference Intakes for Koreans by the Korean Nutrition Society published in 2010.^d Percentage (%) of recommendation = (consumed number of servings/recommended number of servings) × 100.

oils–fats–sugars group, and mixed food items were also assigned common serving sizes and food groups. Overall, the calculation of food group intake in the Korean population was made possible by developing a food group database that more closely reflected actual intake of foods. Establishing the food group database enabled actual servings consumed by Koreans across sex and various ages to be evaluated based on the KFGS recommendations. In addition, our database can be used to draw associations between food group intake and risk of diseases. Bradlee et al. (2010) used

USDA MyPyramid Equivalents Database to examine the association between food group intake and obesity in children and adolescents. Jung et al. (2011) examined the association between food group intake and metabolic syndrome abnormalities using our food group database.

Food consumption is investigated in grams per day in most large-scale dietary surveys, including KNHANES, but the use of food weight alone has a limitation because it does not take moisture level or solid content into account. For example, 100 g of

a certain food in dry form would be equivalent to 100 g of the same food in fresh form in terms of weight status. However, a crucial difference lies when it comes to consumption; the equivalent weight of the dry form would contribute several times more servings than the fresh form, hence it would be more appropriate to use servings as the intake unit in place of weight (Sharma et al., 2003a). Since food codes used in our food group database correspond with those in the Food Composition Table and the KNHANES data, the database can be used in measurement and assessment of food consumption widely.

In order to be able to assess food intake more accurately, a detailed food guide is required. The USDA MyPlate includes five food groups that are further divided into subgroups with serving size information that provides a more detailed guideline (USDA, 2011) and the MyPyramid Equivalents Database provides a set of recommended servings for 32 subgroups of foods (USDA, 2008). For example, the grains group is divided into whole grain and non-whole grain; the vegetables group is specified as dark-green, orange or white potatoes. More detailed food-based dietary guidelines for Koreans might be helpful to improve consumption of whole grains and various vegetables and fruits that are emphasized to achieve good diet and health (Paik et al., 2008; Song et al., 2012). In addition, the meat–fish–eggs–beans group – which includes protein source foods – needs to be classified into subgroups according to source of protein (e.g. animal or plant) or fat contents.

In our food group database, oils that were added during cooking and fats/sugars that were added to bread, snacks, and processed foods were not divided separately from the oils–fats–sugars group. MyPlate suggests that added fat and sugar be classified into the calculation discretionary energy when the food group intake is assessed. Also, the assessment of intake of added fat and sugar is separated from the consumption of oils used in cooking (USDA, 2011). Consumption of foods with added fat and sugar is one source of excess energy intake, and it may be associated with the risk of obesity and chronic diseases (Cohen et al., 2010; Malik et al., 2010).

In the present study, the food group intake was determined by sex and age group from a nationally representative sample with appropriate sampling weights from the national survey. However, our study has several limitations. It was difficult to estimate the usual intake due to intra-individual variance not being accounted for in this study when calculating food group servings from the single 24-h recall data. As a result we could not estimate the proportion of population that consumed fewer than the recommended servings. Height, weight, and physical activity levels were not considered in evaluating food group intake based on the estimated energy requirement.

5. Conclusions

The food group database for 4370 food items commonly consumed by Koreans can be an efficient tool to guide and assess food group intake of the Korean population. Food group intake of Koreans differed by sex and age group. Adolescents had lower-than-recommended numbers of servings of all food groups except for grains and oils–fats–sugars. Among middle-aged adults, men consumed only half the recommended servings of fruits and milk-dairy products. As for the elderly, food groups whose intakes were lower than the recommended servings were meat–fish–eggs–beans, milk-dairy products, and oils–fats–sugars.

Our research makes an important implication on developing nutrition education and food-based dietary guidelines for populations for whom certain food group intakes have been compromised. In addition, the database established in this study could be used for documenting the nutritional needs of a target population

in developing nutritional policy and strategy for the promotion of public health.

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